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A STREPTOTHRIX (NOCARDIA) INFECTION OF COWS' UDDERS

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Four and one-half years ago a study of the bacterial contamination of cow's milk as it comes from the udder was undertaken by the writer. At that time a number of samples of milk from the Dairy Division herd at Beltsville, Md., were studied and 2 or 3 times each year since a number of samples (usually from 20-30) from this herd have been carefuly examined. At the time of the last examination of samples, in Jan., 1918, it was found that some time since Oct., 1917, when the preceding examination was made, there had been a general infection of the udders with a streptothrix (Nocardia). It was isolated from 18 of 21, or 85.7%, of the samples studied. The number of streptothrix colonies which grew on the plate indicated that the numbers of these organisms in the samples of milk when it was drawn varied from 140-2,600 per c c. It had never before been isolated from the milk of this dairy.

A search through the literature yielded only 2 references to the findings of streptothrix in milk. One was in the writer's paper[1] on the "Bacteria of Milk Freshly Drawn from Normal Udders." There it was reported that "A streptothrix was found in 6 of the 28 samples of milk from Dairy 3. In one sample there were 5,000 of these organisms per cubic centimeter." Thöni[2] reported that he found streptothrices in the market milk of Bern, Switzerland, and Barthel,[3] a Swedish investigator, reported finding them in milk, but he found them also in the air of the stable, and therefore concluded that those in the milk were due to air contamination. Since streptothrices are common saprophytes, it is probable that those isolated by Thöni got into the milk after it was drawn. Presumably, then, the streptothrix infection of the udder was unusual, for otherwise it would have been noted by others of the investigators who have studied the bacterial flora of aseptically drawn milk.

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[1] Jour. Infect. Dis., 1916, 18, p. 437.

[2] Gesundheitsamt, 1914, 5, p. 9.

[3] Milch-Zeitung, 1903, 32, p. 658.

DESCRIPTION OF THE ORGANISM

Morphology.—In a young vigorously growing culture, the streptothrix consists of long branching mycelial threads, which afterward break up into rod forms of various lengths. The rod forms are in turn converted into coccoid forms which occur isolated or in chains held together by the remnants of the old mycelium. The coccoid forms are the result of "chain sporulation." If the medium is dry, a powdery growth appears, in which true conidia are formed at the ends of lateral hyphae, together with all the other forms the organism may assume. The morphology of this milk streptothrix is splendidly illustrated in the colored plates of Claypole's "Classification of the Streptothrices,"[4] to which the reader is referred. All the forms represented in Figures 1, 2, 3, and 4 of Plates 8 and 9 were found also in cultures of the milk streptothrix.

Straining.—The organism is gram-positive. The coccoid bodies and conidia are acid-fast when stained by carbolfuchsin and decolorized with 2% hydrochloric acid in 95% alcohol, as recommended by Jordan[5] for tubercle bacilli. They are also acid-fast when decolorized with 5% nitric acid, as recommended by Hiss and Zinsser.[6] But they are not acid-fast when decolorized with 25% nitric acid, according to the method used by Claypole.[4]

Cultural Characteristics.—On agar slope the growth is usually in discrete colonies about 1½ mm. in diameter. The colonies are wrinkled, with the ridges radiating from a depressed center. Often there is a triangular opening in the center of the colony. Sometimes the growth is confluent, with a wrinkled surface. It is tough and adheres to the agar. The growth itself is of a cream buff color (Plate 19″ YO-Yd of Ridgeway's Color Standards and Nomenclature), and the agar is slightly browned in old cultures. In agar shake culture growth takes place on the surface and on the wall of the tube for about 10 mm. above the surface. On the upper part of slope cultures, where the agar is thin and dry there is often a white powdery growth. It is in this efflorescent growth that the true conidia may be found at the ends of aerial hyphae. In broth cultures the growth is in the form of granules which do not cloud the medium. On potato there is an abundant brownish growth with a honeycombed surface.

Biochemical Reactions.—The streptothrix was quite inert toward the medium in which it was cultivated. It did not attack dextrose, maltose, saccharose, lactose, starch or mannite in broth culture, nor did it reduce the hydrogen-ion concentration of the medium. It failed to decompose nitrate and asparagin, and failed to grow on gelatin at 20 C. It rendered litmus milk alkaline with a slow action.

Thermal Death Point.—The thermal death point of the organism was determined in a whole milk culture 8 days old. It was killed by a temperature of 56 C. for 30 minutes. A smear of the culture for microscopic examination was stained according to the Gram-Weigert method to determine what forms of the streptothrix were present. The long-branched mycelial threads predominated, with a few rods and coccoid forms. No conidia were found and it is probable that there were none in the culture. But it can be assumed that the 8-day culture contained forms as resistant to heat as would occur in milk at the time of pasteurization; therefore, the heat of ordinary pasteurization can be regarded as sufficient to kill the organism.

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[4] Jour. Exper. Med., 1913, 17, p. 99.

[5] General Bacteriology, 1915, p. 48.

[6] A Text Book of Bacteriology, 1915, p. 105.

DISCUSSION

Streptothrices are common saprophytic and parasitic organisms which occur in soil and water, and are associated particularly with herbage. They are the cause of many diseases and infection has in many cases been traced to herbage. Cattle are the most susceptible animals, and the most common diseases caused are lumpy jaw and pneumonia. Foulerton[7] studied 53 cases of streptotrichosis in human beings and found the most common infections were about the mouth or in the neck, as the result of oral infection. The next common seat of apparent primary infection was the appendix, and next was pulmonary infection. In the tropics Madura foot is a common disease caused by a streptothrix. Claypole[8] states that "Streptotrichosis is more common than generally supposed and frequently not differentiated from other infections."

Streptothrices belong to the higher bacteria which form connecting links between the fission fungi and the true fungi, with B. leprae and B. tuberculosis as the most closely related forms of fission fungi. Claypole[4] recognized 11 species of streptothrix pathogenic to human beings. The 11 species showed a series of gradations between Streptothrix hominis III at one end and B. leprae and B. tuberculosis at the other end of the series. The milk streptothrix agreed in morphology, cultural characteristics, biochemical reactions and staining properties with Streptothrix hominis III, which was first described by Foulerton.[7] The milk streptothrix therefore agreed with the species nearest related to the true fungi with long, branched mycelial threads, and common formation of conidia. It was one of the least acid-fast organisms of Claypole's group, and serologically was the most remotely related to B. tuberculosis.

Foulerton[7] isolated Streptothrix hominis III from 3 cases of appendicitis. Any comment on the possible sanitary significance of large numbers of a similar organism in milk would be mere conjecture. Animal inoculation would not give reliable information on this point, for numerous investigators who have studied the streptothrices agree that pathogenicity is not a reliable specific character. There is reason to believe that the organism was not living as an entirely harmless parasite in the cows' udders. Three of the 18 samples of milk from which the streptothrix was isolated gave a sediment containing red blood corpuscles. A fourth sample from which the streptothrix was isolated gave a puslike sediment, but it also contained streptococci in numbers great enough to account for the abnormal condition. Apparently, however, the streptothrix was not causing any serious udder trouble, for a month after the samples of milk were examined the dairyman in charge reported that he had not noticed any unusual condition.

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[7] Lancet, 1910, 178, p. 626.

[8] Arch. Inter. Med., 1914, 14, p. 104.

The finding of streptothrices in milk does not add to the precautions which should be observed to safeguard against infection by food substances. It merely adds a fourth organism to the 3 types of bacteria of a suspicious character already known to occur in milk freshly drawn from normal udders — the streptococci, the staphylococci, and the rod-forms of the Bact. abortus type. Strains of all 3 of these organisms, which produced disease when inoculated into experimental animals, have been found in milk. Melvin's[9] statement in regard to Bact. abortus can be applied also to the streptothrix: "Although we do not know what effect it may have on human beings, we cannot afford to assume that they are not affected by it." The streptothrix may prove to be still another source of danger in the use of raw milk as food, and may furnish an additional reason for taking advantage of the safeguard afforded by pasteurization.

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[9] Twenty-Eighth Ann. Report Bur. An. Ind., Department of Agriculture, 1911, p. 137.